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ABSTRACT

Computer-based support services needed by individual planners/managers in small academic units (deans' and department heads' offices) within a larger higher education environment should provide the capability to interact easily and inexpensively with powerful information systems which allow the planner to integrate data from several sources, test alternative plans, prepare reports, and communicate with other information systems, all without the need for expensive technical support. This paper: (1) reviews the literature on typical information services for planning; (2) shows how normal campus data processing services, useful for the majority of users, have inherent limitations when it comes to the support of individual planners; and (3) presents a case study and describes some general lessons learned about personal use of microcomputers through studying one campus administrator. (THC)

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INFORMATION SUPPORT FOR PLANNING IN ACADEMIC SUBUNITS*

BERNARD S. SHEEHAN
PETER R. NEWSTED

WP NO. 18-84

Faculty of Management
The University of Calgary
Calgary, Alberta, Canada
T2N 1N4

(403) 284-7159
(403) 284-6993

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INFORMATION SUPPORT FOR PLANNING IN ACADEMIC SUBUNITS

ABSTRACT

Individual planners need personalized information system support which is not now available from campus services. These decision support systems must match closely each planner's requirements for data, information, reports and modelling and must do so cheaply, and not require data processing expertise. Planners can build their own information support systems if they have the proper tools. A case study demonstrates how such capabilities were provided to one campus administrator and what was learned about these personal systems.

Introduction and Perspectives

Although we are in the midst of an information technology revolution, there are still many needs for information to support planning which are not being met. The change on campus from a centralized data processing service which provides basic operating and management information toward a more decentralized situation has not been fully implemented. Individual planners and administrators need easy, friendly access to computer-based services which provide practical support without all the delays, costs, restrictions and complications that have traditionally faced planners and other end users of computer services. Many planners and other professionals on campus have an urgent need for personalized and nonroutine services.

This paper defines the sort of capabilities needed by many individual planners/managers working in smaller academic units such as deans' offices and department heads' offices. These capabilities include the ability to easily and cheaply interact with powerful information systems which allow the planner to integrate data from several sources, to test alternative plans, to prepare reports, to communicate with other information systems all without the need for expensive technical support. Specifically, the paper:

1. Overviews the literature on typical information services for planning.
2. Shows how normal campus data processing services, useful for the majority of users, have inherent limitations when it comes to the support of individual planners; and, will argue th planning support systems on professional microcomputers overcome these limitations.

3. Illustrates a case system and describes some general lessons learned about personal microcomputers.

Literature Overview and Background

Over the past two decades there has been considerable experience with the application of information technology to planning and management in higher education and a corresponding interest in business on the use of computers as management information systems (MIS) and decision support systems (DSS). The literature on the use of information technology for decision support in higher education is too extensive to review in detail here. Recently the literature on DSS has been compiled into a few textbooks which are excellent sources, these include Sprague and Carlson (1982) and Bennett (1983). Sheehan (1982a,b) contain bibliographies on analysis and technology to support planning and management in higher education.

The literature on the more specific and recent phenomenon of the use of personal computers by individual staff members and executives is, of course, not yet as well developed. Experience is still being gathered on the impacts of microcomputers in various configurations on the processes and organizations of planning and management in higher education. Perhaps the best sources of current information are recent publications and proceedings of organizations such as the Association for Institutional Research, CAUSE, EDUCOM, National Center for Higher Education Management Systems, Society for College and University Planning, and publications such as the EDP Analyzer, Computing Newsletter for Schools of Business, and the trade press including Computerworld and Datamation.

The Inherent Limitations of Traditional Data Processing Support for Planning

Normal data processing services useful to the majority of users have inherent limitations when it comes to support of individual planners. Electronic data processing focuses on data, storage, and processing flows at the operational level. This emphasis on transaction processing in scheduled computer runs with occasional summary reports for management is not what the planner in a small unit needs, although, transaction data are often useful for other aspects of management. Management information systems widely developed on

campuses provide inquiry and report generation services. However, because information flows are often structured so as to match institutional planning and management processes, it is awkward to get customized, ad hoc, timely reports especially for users outside the regular administrative groups or procedures.

What the individual planner wants are information services that are much more decision oriented. This person wants systems that are flexible, adaptable and can respond quickly to user initiatives and that remain under his or her control so that they can support the personal planning and decision needs of the user. We know from many years of evolution of management information systems that the planner, and other decision makers, cannot spell out their information needs in advance but come to specify more tightly their requirements as they experiment with prototype systems or sample reports. Thus, it is evident that the sort of planning support systems that are needed have to be specified by their information related abilities or features. Since these are personal rather than institutional tools, they will basically be decision process independent. That is, these information systems must provide the individual planner with easy to use capabilities that are valuable in all phases of decision making from gathering background information through the design of alternative plans, and the testing and implementation of a final program.

Some new alternatives available to planners: Many of the features of the required planning support system can be developed by each planner if suitable tools are available. Depending on the individual's background, it may be necessary for the end user to get technical help at the beginning. If such help is necessary, it is often available through an information center which is becoming an increasingly popular unit in many organizations. Martin (1983) deals with end user application development and the information center. Newsted (1983) describes the notion of the information center in higher education. The tools used by information centers, particularly, nonprocedural languages which have been implemented on micros, are especially designed to be used by people without programming skills. Such people are principally interested in solving their own professional problems through the use of these tools. The characteristics of many of the nonprocedural languages and high-level application tools like FOCUS, RAMIS II, MAPPER, NOMAD and NPL are described by Martin (1982), McCracken (1980), Truitt and Mindlin (1983), and others. These tools allow users to say what they want accomplished without

bothering about how systems are programmed.

Nonprocedural languages on professional microcomputers provide many of the DSS capabilities including those needed for planners' personal systems tool kits. These capabilities have been classified by Sprague and Carlson (1982) as dialog, data and modelling. Person-computer dialog characteristics of any DSS are, in many ways, the most important because if the interface between the machine and the planner is a barrier then the other features of the equipment, no matter how powerful, will not be used. The second set of capabilities relates to how the system manages data, this includes questions related to sources, definitions and structures, storage, manipulation, retrieval and reporting. The modelling capability which has to do with the ability to build, store, test and run models is an imperative feature for planners.

Some of these features are available on common microcomputer software packages such as a spreadsheet in Visicalc, or the spreadsheet plus simple list processing and sorting and graphics in Lotus 1-2-3. However, fourth generation languages (4GL) on micros offer the end user further flexibility and personal control over the dialog and a powerful data base management system well integrated with the dialog. These micro based systems are not yet ideal with respect to modelling and model management capability but many of the traditional problems with computer-based planning models can be eliminated - mostly because the system stays under the developmental and operational control of the planner/user. Integrated with spreadsheet programs or financial modelling and graphics systems, 4GL can provide enhanced capabilities in a planner's individual workstation.

A Case Example

In order to demonstrate this approach, actual data on 354 students currently enrolled or taking preliminary courses in the University of Calgary's MBA program were taken as a test data base. In response to the needs of the director of the MBA program, it was clear that there were numerous questions that he wished to ask about students which could not be easily provided by the standard student information system maintained on the administrative mainframe. Though it was relatively easy for him to get reports on which students had taken which classes or to see a given student's record, he could not ask questions such as "How many students still need to take the core courses in information systems?" followed by "and how many of them have been in the program for

more than two years?" and, "by the way, could you print out mailing labels for their home addresses?". The only data the director had access to was stored in a traditional IBM environment, that is, an IMS data base with reporting through COBOL programs and data entry at CICS screens.

With this as a starting point, there were a number of problems to surmount before "what if" and "ad hoc" reporting capabilities could be provided. Firstly, the IBM data had to be transferred to the microcomputer running a nonprocedural language (in this case NPL on a Digital Equipment Corporation PRO 350). A tape was created of all student information for the 354 MBA students, and loaded on the University's Honeywell mainframe where it could be altered into the required format. Six different files were created each reflecting a simple view of different aspects of the student information: demographic data, undergraduate records, courses taken, grades received, etc. Though this could have been done on the IBM mainframe, there was no dial-in access to this mainframe for security reasons. Connecting the professional level microcomputer as a terminal over a 1200 baud line required the expertise and experimenting of the University's Academic Computer Center staff in order to determine the required transmission characteristics (see Technical Note 1 for more information on transferring and entering data).

Once the six files were on the PRO, things became much easier. They were readily accessible to NPL after the formats were defined in NPL's interactive data description. This proved to be comparatively simple as it was all menu-driven. From this point, retrieval and updating of data were straightforward with NPL's English-like reporting commands and simply defined screen formats. However, difficulties were encountered with building elaborate reporting capabilities that involved the joining or projecting of several files — as would be possible in a fully relational system. This was overcome by restructuring the data in one single large file. Retrieval performance suffered as a result, and the implementation of a fully relational system is currently being sought. It was also not possible to have variable length records in NPL as even a simple heirarchical data base would allow.

This part of the example illustrates how costly in terms of manpower it was to do the first transfer of data, and initially to learn to use NPL effectively. Further transfers can, of course, proceed much more smoothly as the conversion programs are now in place. It should also be possible for new users of NPL to pass Martin's "two day test" (1982, p. 107), in terms of the time initially needed to learn and use the system. As it was, at least 40 hours of the

two authors' time was required to fully explore and understand the capability of this nonprocedural system. The MBA director and his staff, however, were easily able to master simple retrieval and updating in one afternoon session, though backing up of data (stored on the system's hard disk) onto floppy disks for offsite storage required further instruction.

Illustrations of Queries/Responses Using a Nonprocedural Language, NPL

To get the best idea of what a tool such as NPL can actually accomplish, it is useful to follow through an actual NPL session on the microcomputer on which it was implemented for this case example. The PRO 350 uses a menu-driven system to invoke applications. A choice of a menu item is initiated by moving the cursor and pressing the DO key — occasionally other specific function keys such as EXIT or RESUME are used.

The first menu a user sees is shown in Figure 1. The "->" symbol indicates the cursor which in Figure 2 has been moved to the NPL system. After pressing DO, the menu in Figure 3 appears indicating the three main choices available to an NPL user. The first one is used almost exclusively (with the other two involving storing NPL commands and configuring the NPL system respectively). This first choice allows selection of a data description or "master file" to be chosen for producing reports or updating data. Figure 4 shows the screen this choice produces, and the selection of the MBA data description along with the associated data.

Once the MBA master file and its data are chosen, the screen in Figure 5 appears allowing a user to select an operation to be done on the current file. Inquiry is done by choosing REPORT. In Figure 6 and the following several figures, being in the "report mode" is indicated by the "R>" prompt. Figure 6 shows a very simple report from the MBA data. It shows the first screen of data that results from requesting a print of student name, birth year and sex. Figure 7 shows the count command which indicates there are 354 records in total. Figure 8 is a useful digression which shows the full structure of this file which needs to be kept in mind for further use of the reporting requests. Figure 8 lists all 57 fields of the MBA data file. The first 10 are obvious demographic fields and the remaining ones hold course information. Though blank in this example, the ALIAS column indicates that a second — typically shorter — name for any

Figure 1: Main microcomputer menu.

```
                    MAIN MENU - P/OS V1.7


Copyright © 1983 Digital Equipment Corporation
For information on using the Professional, press HELP.


   ->

         PROSE
         Command Language
         NPL Information Management System
         PRO/Communications Version 1.7
         Supercomp-Twenty V1.21
         Disk/diskette services
         File services
         Print services
         Additional applications
         View Message/Status


Make a choice and press DO:
```

Figure 2: Choosing an application from the main menu.

```
                    MAIN MENU - P/OS V1.7

Copyright © 1983 Digital Equipment Corporation
For information on using the Professional, press HELP.

          PROSE
          Command Language
     ->   NPL Information Management System
          PRO/Communications Version 1.7
          Supercomp-Twenty V1.21
          Disk/diskette services
          File services
          Print services
          Additional applications
          View Message/Status


Make a choice and press DO:
```

Figure 3: Selecting on NPL master file.

```
                    NPL MAIN MENU


    ->   GET a master file
         EXECUTE an NPL program
         SET menu


                              Additional Options Available

Make a choice and press DO, or press EXIT
```

Figure 4: Picking a specific master file (and an associated data file)

File Selection Menu

Which file do you want to get?
Current directory is ZZAP00004 on Volume BIGVOLUME

	Name	Type	Version
	PERSONNEL	.MAS	1
	MAILIST	.MAS	1
	DPERSON	.MAS	1
	MBABACKUP	.MAS	1
->	MBA	.MAS	8
	BILL	.MAS	1
	CUSTOMER	.MAS	1
	BOOKS	.MAS	1
	PENDING	.MAS	1

Additional Options Available

Select up to 1 items
(1 chosen)

Figure 5: Selecting the report option for the chosen file.

```
                        NPL MAIN MENU


CURRENT FILE: MBA

          GET a master file
          EXECute an NPL program
          SET menu
          MODIFY current file
     ->   REPORT from current file
          Field operations


                                  Additional Options available


Make a choice and press DO, or press exit
```

Figure 6: A simple report.*

```
R>print name year sex.
```

NAME		YEAR	SEX
ABT	RITA	42	F
AMSON	JACKSON	53	M
ANDER	AARON	45	M
ANDERSON	ALBERTA	38	F
ARN	PAULINE	41	F
ARNOLD	PETER	53	M
BABSON	JACK	44	M
BADON	PENELOPE	48	F
BALOR	RONALD	53	M
BARMANN	RICHARD	48	M
BALLSKI	VIC	49	M
BANTOUR	DORIS	50	F
BARKER	JULIE	52	F
BARNEY	GARY	43	M
BARRETT	MICHAEL	53	M
BARRETT	CRAIG	47	M
BASS	BRAD	52	M
BATMAN	JOSEPHINE	45	F

*NOTE: Though based on real data, all names and demographic characteristics have been altered and hence are strictly fictitious in these illustrations.

Figure 7: Counting all records.

```
R>count name.


COUNT

   354

R>
```

Figure 8: The full description of the MBA data.

FILE: MBA

RECORD LENGTH: 484 RECORD TYPE: FIXED

FIELD NAME	ALIAS	PRINT
KEY		A 6
NAME		A28
ADDRESS		A42
POSTAL CODE		A 6
SEX		A 1
DAY		A 2
MONTH		A 2
DEGREE		A 3
ACCT		A49
FNCE1		A28
FNCE2		A49
MGIS		A14
MGSC		A28
MGST1		A21
MGST-607-YR		A 2
MGST-607-SES		A 1
MGST-607-GR		F 6.2
MGST2		A28
MKTG-625-YR		A 2
MKTG-625-SES		A 1
MKTG-625-GR		F 6.2
MKTG-661-YR		A 2
MKTG-661-SES		A 1
MKTG-661-GR		F 6.2
MKTG-761-YR		A 2
MKTG-761-SES		A 1
MKTG-761-GR		F 6.2
MKTG-763-YR		A 2
MKTG-763-SES		A 1
MKTG-763-GR		F 6.2
MKTG-767-YR		A 2
MKTG-767-SES		A 1
MKTG-767-GR		F 6.2
MKTG-785-YR		A 2
MKTG-785-SES		A 1
MKTG-785-GR		F 6.2
MKTG-793-YR		A 2
MKTG-793-SES		A 1
MKTG-793-GR		F 6.2
MKTG-795-YR		A 2
MKTG-795-SES		A 1
MKTG-795-GR		F 6.2
MKTG-799-YR		A 2
MKTG-799-SES		A 1
MKTG-799-GR		F 6.2
MOHR1		A35
MOHR2		A35
POEN		A35

field could also be defined. Technical Note 2 gives more detail on the creation of this record.

All records required fields for all courses because NPL does not provide a full relational data base which can link many small files. Instead, all data are stored in one huge flat file: 354 records long by 484 characters wide. For this illustration all courses have not been broken out separately and most were lumped together in wide fields. However, within the marketing discipline, each course is represented by three fields: year taken, session taken, and numeric grade (on a four point scale). Figure 8 indicates the printing formats for these fields using standard FORTRAN notation where an A indicates alphanumeric data (e.g., A28 for a name of 28 characters), and F indicates fixed decimal data (e.g., F6.2 for 5 decimal digits plus a decimal point before the last two digits).

With this description of the data in mind, further illustrations of the reporting option can be considered. Figure 9 shows an IF statement which counts just those students who have officially been admitted to the MBA program as opposed to those who are as yet unclassified and just taking MBA foundation courses. Figure 10 is another illustration of IF where those students born between 1920 and 1940 are listed. This list has been sorted both BY year and sex.

Figure 11 shows the use of a "mask" with dollar signs to find those students whose postal codes do not contain a "T" as their first character — thus indicating they are from out of province. The two students which this selects have their addresses printed with the IF in the bottom of Figure 11.

Figure 12 gives an illustration of the first screen of data which is produced when grades for a specific course in a particular year and session are requested. Note here that the request for this report continues over several lines and is only acted upon when it ends with a period. Figure 13 further reports on this marketing course by showing how to obtain the average grade by sex for all students currently in the MBA program who have taken this course. A frequency count is also included. It should be noted that an artifact of this use of NPL with this large flat file for all courses has necessitated the use of the "if mktg-661-gr gt 0" to select only those students who have actually taken the course — as all students have a field for this course (cf. Technical Note 3). Figure 14 shows a

Figure 9: Counting selected records.

```
R>if degree eq MBA count name.

COUNT

  271
```

Figure 10: Printing records which meet a particular criterion

```
R>if year eq 20 to 40 print name by sex by year.

Sorting.................
```

SEX	YEAR	NAME	
F	26	LICKER	ANNE
M	24	MUNRO	RICHARD
	28	ALTER	RONALD
	36	CHARDSON	HARRY
	38	GRAHAM	ARNOLD
		MAHER	JAMES
	39	WAGNER	WALTER
	40	JONES	KEITH
		WARREN	MORRIS

Figure 11: Selecting records whose fields omit certain characters.

```
R>if postal omits T$$$$$ print name by postal.

Sorting.................

POSTAL CODE     NAME

M4A1T9          NEILL           FRED
S7K4T6          DUTTON          SUSAN

R>if postal eq M4A1T9 or S7K4T6 print address.

ADDRESS

381 WINDY DRIVE                         OTTAWA ONTA
6134 QUELL ST                           REGINA SA

R>
```

Figure 12: Part of a specific class grade list.

```
R>if mktg-661-yr eq 83
R>if mktg-661-ses eq 1
R>    print name mktg-661-yr mktg-661-ses mktg-661-gr.
```

NAME		MKTG-661-YR	MKTG-661-SES	MKTG-661-GR
ASTOR	RICHARD	83	1	4.00
BARKER	JULIE	83	1	3.70
BATMAN	JOSEPH	83	1	3.00
BOOR	DICK	83	1	3.70
BYSCH	RALPH	83	1	3.30
CASTOR	GARY	83	1	0.0
CHARLES	DONALD	83	1	3.00
CINWAY	TERRY	83	1	3.30
COLDSON	BRUCE	83	1	3.30
DONALD	JACK	83	1	3.30
FREEMAN	LARRY	83	1	4.00
FORELOW	CATHERINE	83	1	3.70
GERRY	LINDA	83	1	3.70
GRANTER	LORNE	83	1	2.70
GROSS	JERROD	83	1	3.70

Figure 13: Producing summary statistics for all students who have taken a particular course.

```
R>if mktg-661-gr gt 0 write avg.mktg-661-gr count sex by sex.

Sorting.................

        AVE
SEX     MKTG-661-GR     COUNT

F              3.68        71
M              3.39        27
```

Figure 14: Selecting students who have taken two particular courses (with an example of how NPL syntax errors are corrected).

```
R>if mktg-661-gr gt 0
R>if mktg-763-gr gt 0
R>print line# name mktg-661-gr mktg-763-gr.

Unknown name : LINE#
Please replace : row#
```

ROW	NAME		MKTG-661-GR	MKTG-763-GR
1	EDMAN	MANUEL	3.00	3.00
2	STERN	CATHLEEN	4.00	4.00
3	SAUL	KATHY	4.00	4.00
4	DONALD	JACQUES	3.70	4.00
5	LAUCHLAN	GEOFFREY	3.70	3.30
6	TRAHAMOVICH	RYAN	3.30	3.30
7	DONWAY	TERRY	3.70	3.30
8	CONNELLY	CHRISTINE	4.00	3.70

combined IF request which extracts only those students who have taken two particular marketing courses. This figure also shows how NPL prompts for replacement of an unknown term.

Figure 15 shows a particularly useful and desirable feature of NPL. Here a screen of abbreviated mailing labels are produced for those students who have not taken this required marketing course. This ability was found to be desirable by the MBA office which wished to conduct mailings to such students alerting them to when this course was likely to be offered in future terms.

Moving from reporting to modifying or entering data, Figure 16 shows the NPL menu choice to either run and modify data or append data to the file. Having chosen RUN in the modify mode, the "M>" prompt appears on the next screen followed by the first record in sequential order.

Moving the cursor will display further fields not already on the screen. Both of these screens are seen in Figure 17. Pushing return displays successive records. At any point in any record, new information can be entered or typed over existing information, or if the APPEND option were chosen, a record with all blank fields would be displayed that could be filled in with a new student's data.

One disadvantage of searching a record sequentially (in this case by student identification number or "key") is that a particular record may take quite a while to find. To overcome this, an index can be built using a given field so that a record can be found almost instantly. Figure 18 illustrates a further NPL menu which allows this. Figure 19 shows the results of indexing the MBA data based on name. The processing in this Figure is not quick, however. It took six minutes of processing time to build the name index. Fortunately this would only need to be done when the system was implemented, and not when it was to be used. It is also significant that building this index causes the data file to take up more than twice the space it did before the index was built. Curiously, adding secondary indexes (such as id key or postal code) only requires a further 5 to 10 percent memory for each secondary index. Figure 20 shows the use of the index (also cf. Technical Note 4). The first record to appear is the alphabetically first one; and as indicated in Figure 21, typing another last name causes that record to come up immediately in Figure 22. This

Figure 15: Producing mailing labels for students who have not completed a required course.

```
R>if degree eq MBA
R>if mktg-661-gr le 0
R>print name over address skip 2.


BRYCE              ANDREW
5115 HURST CR                        DUCHESS ALTA

WRITE              RICHARD
4112 181 AVE SW                      COCHRANE ALTA

LUNDEN             KEITH
3240 DALE PL N W                     RED DEER ALBE

BERT               MORRIS
332 BART ROAD S W                    EDMONTON ALBE
```

Figure 16: Selecting the running of the modify option to change data.

```
                    Modify Menu

->          RUN
            APPEND


Make a choice and press DO, or press EXIT
```

Figure 17: Two screens illustrating the contents of the first record which can be modified.

```
                M>
                KEY              :  002134
                NAME             :  DAVIS            ANDREW
                ADDRESS          :  3115 HURST ST SW      CALGARY ALTA
                POSTAL CODE      :  T2V3C6
                SEX              :  M
                DAY              :  03
                MONTH            :  29
                YEAR             :  41
                DEGREE           :  MBA
FIRST           ACCT             :
SCREEN:         FNCE1            :  8410.00
                FNCE2            :
                MGIS             :
                MGSC             :  8354.00
                MGST1            :  8314.00
                MGST-607-YR      :
                MGST-607-SES     :
                MGST-607-GR      :
                MGST2            :  8410.00
                MKTG-625-YR      :
                MKTG-625-SES     :
                MKTG-625-GR      :

                MKTG-661-YR      :
                MKTG-661-SES     :
                MKTG-661-GR      :
                MKTG-761-YR      :
                MKTG-761-SES     :
                MKTG-761-GR      :
                MKTG-763-YR      :
                MKTG-763-SES     :
                MKTG-763-GR      :
SECOND          MKTG-767-YR      :
SCREEN          MKTG-767-SES     :
                MKTG-767-GR      :
                MKTG-785-YR      :  84
                MKTG-785-SES     :  1
                MKTG-785-GR      :  0.00
                MKTG-793-YR      :
                MKTG-793-SES     :
                MKTG-793-GR      :
                MKTG-795-YR      :
                MKTG-795-SES     :
                MKTG-795-GR      :
                MKTG-799-YR      :
                MKTG-799-SES     :
                MKTG-799-GR      :
                MOHR1            :
                MOHR2            :
                POEN             :
```

Figure 18: Selecting the indexing option.

```
                    NPL Field Operations

              FILE?
              DEFINE field
              REPLACE field
        ->    INDEX field
              SELECT field index
              CLEAR


Make a choice and press DO, or press EXIT
```

Figure 19: The screen displayed while indexing is in progress.

```
C>INDEX
INDEX what field?   name

Sorting.........

External Sort initiated
.......

Merging.

Writing new INDEXed data file
..................

Writing new master file.

-------- Press Return to continue -------
```

Figure 20: The first part of the first record after indexing by last name.

```
INDEX=NAME              M>
KEY              :  846318
NAME             :  ABT              RITA
ADDRESS          :  125 UMMERFIELD ST       LETHBRIDGE ALBE
POSTAL CODE      :  TOMOB5
SEX              :  M
DAY              :  04
MONTH            :  11
YEAR             :  59
DEGREE           :  UNC
ACCT             :
FNCE1            :
FNCE2            :
MGIS             :
MGSC             :
MGST1            :  8414.008414.00
MGST-607-YR      :  84
MGST-607-SES     :  1
MGST-607-GR      :     4.0
MGST2            :
MKTG-625-YR      :
MKTG-625-SES     :
MKTG-625-GR      :     0.0
```

Figure 21: Selecting a new record based on the name index.

```
INDEX=NAME              M>SAUL
KEY              :  846318
NAME             :  ABT              RITA
ADDRESS          :  125 UMMERFIELD ST      LETHBRIDGE ALBE
POSTAL CODE      :  TOMOB5
SEX              :  M
DAY              :  04
MONTH            :  11
YEAR             :  59
DEGREE           :  UNC
ACCT             :
FNCE1            :
FNCE2            :
MGIS             :
MGSC             :
MGST1            :  8414.008414.00
MGST-607-YR      :  84
MGST-607-SES     :  1
MGST-607-GR      :     4.0
MGST2            :
MKTG-625-YR      :
MKTG-625-SES     :
MKTG-625-GR      :     0.0
```

Figure 22: The new record found by giving name a value.

```
INDEX=NAME              M>
KEY              :  701224
NAME             :  SAUL              KATHY
ADDRESS          :  1011 LANDS BLVD SW    CALGARY ALBE
POSTAL CODE      :  T3G1Y4
SEX              :  F
DAY              :  02
MONTH            :  07
YEAR             :  63
DEGREE           :  MBA
ACCT             :           8014.00
FNCE1            :  8413.00
FNCE2            :
MGIS             :  8213.30
MGSC             :  8154.008254.00
MGST1            :  8054.008113.70
MGST-607-YR      :  84
MGST-607-SES     :  1
MGST-607-GR      :     3.70
MGST2            :
MKTG-625-YR      :
MKTG-625-SES     :
MKTG-625-GR      :     0.0
```

ability to access records quickly clearly makes random modification an easy task.

Lessons We Have Learned

Given this case and these examples, it is appropriate to consider a number of key things about hardware and software techniques which we learned or perhaps relearned.

1. **Technology is not bug free, it is useable but not perfect**

Interface problems: There are many variations on the interface problem. The one we experienced had to do with using an early version of an advanced software package with an early version of hardware, running on a recent version of an operating system. While each element was an excellent advance on the previous version, complex systems cannot be expected to work perfectly together without exhaustive testing. Even when the manufacturer supplies competent and enthusiastic service (as was our experience), the suppliers' people are often not a great deal more experienced in the particular problem of interface than the user. Usually problems encountered can be resolved. This is especially true for those end users who have experience in data processing. Nonetheless, such "fixes" can be so time consuming that a user may just run out of time. If the applications and technological environment is reasonably volatile, it may not be worth much of the user's time to make particular packages work. On the other hand, if the application is to run for a long time, be essentially maintenance free once it is in place, then it is worth a lot of up front effort. Remember, there are still people running payroll on what amounts to an IBM 1401 — 20+ years later.

Buy or wait: Every user has to ask the question of how much they are prepared to cope with, that is, does one jump in now or wait. The advertising for new information technology products is very effective and makes the user feel confident. It seems the best answer to the question "when do you jump in?" is when you think that a particular combination of technologies meets your needs.

2. **Systems must have data structures which can be used flexibly**

When it turned out that the version of the nonprocedural language we were using was not relational, though we had thought it was when we ordered it, the main lesson we learned was the importance of flexible data structures in meeting ad hoc requests. Since these decision support tools are independent of decision processes and are to be flexible enough to adapt to users' changing and often inarticulated needs, the system has to be able to respond to questions that were not thought of originally. The system has to use relational verbs such as select, join and project. The capabilities these verbs imply permit the combining and selection of data from more than just one file. This allows answering ad hoc and unexpected requests for data because the data structure (though physically fixed) can be logically modified to meet different user needs at different times.

Another lesson we learned when we found that the version of the language we acquired was not relational was that if you want to buy specific features, characteristics or capabilities in the software, then the sort of careful technology scan and evaluation done traditionally in data processing ought to be done by the end user. In retrospect, our decision was not a casual one. We had read a book on the language, but we did not ask for detailed manufacturers' literature on the specific software product we bought. For a variety of reasons, we did not feel we could do the sort of careful acquisition that would be necessary to guarantee that what we got was actually what we wanted. The lesson we have distilled from this experience is that end users do not have the time nor probably the understanding to specify the technology with the exact capabilities needed until after they have experience prototyping the DSS they want to build.

3. **The data is wrong**

This question of measurement is sure to spark controversy between the data user and the data supplier but our experience is that it is almost an axiom to bet that the data will be "wrong" - that is, it will not be right for current purpose. Whether in machine readable form or in hardcopy, the data are not in the format that one needs, are not up to date, are not in the most convenient aggregation or disaggregation,

data items are not conveniently defined, the data base is not appropriately maintained and so on. Witness even the simple differences in abbreviating Alberta in the previous example Figures (viz ALTA and ALBE). There is really nothing very new in this discovery to someone who is used to working in institutional research or related fields but it is worth noting in the context of the acquisition of these new personal devices that one ought not to acquire new technology assuming that:

- Using new technologies solves the traditional information analysis problems;
- Using new technologies short-circuits the planning process;
- The introduction of micros and personal computers is immune to the normal resistance to innovation type of problems. There are many nervous new users;
- My micro will make the data right.

4. **It is fun to play with the new information technology**

For some users, the new information technology is seductive and there are a number of ramifications:

- People spend more time than they need developing applications because end users are curious about the many interesting, but not strictly relevant, features of their systems;
- Application development is not as frustrating as it might otherwise be because end users feel they are investing time in a better understanding of their own personal technology;
- The cost of applications may be higher because users expand systems beyond what would be strictly justified on the basis of relevant business needs so that their systems will be capable of allowing them to engage in junk computing that distracts, amuses and even teaches people about I/S;
- Access can be or can be seen to be an avenue to power in the sense that certain users are able to do things that others cannot.

5. **Making computers personal does not make systems easy to manage**

Personal computer systems are changing rapidly compared to the time intervals between end user application developments. These are complex systems in the sense that the hardware is advanced and changing rapidly even in its basic architecture and component configurations. Operating systems are evolving to keep up with the need to match properly the new hardware characteristics with the even more volatile software packages which not only go through many "generations" but many versions in a short period of years.

This constant state of flux is not new to data processing, it is the standard operating environment for professional computer centers. However, the PC owner/end user, even if he or she is a bit of a hacker, cannot give the important "systems" decisions the priority they require. Consider the following six points:

- Hardware - how and when should you upgrade your basic hardware components?
- Memory - when and at what cost should the several elements of your system memory be expanded or upgraded?
- Printers - what characteristics/features should your system have?
- Communications - which networks should you join? What investment in time should you make studying the alternative mainframes to which you could be connected? What modem characteristics should you acquire and at what cost?
- Operating systems - if you think of the operating system as the means that matches the hardware with various other software such as compilers (languages) but more importantly for most users, with packages (or features) such as: word processors, spreadsheets, nonprocedural languages, communication facilities and graphics, one sees a myriad of decisions about operating systems which are "technical" as well as economic. The end user is primarily interested in functionality or practicality from the perspective of his or her profession or job. The decisions related to operating systems are often not framed in the functional language of the end user but the technical language of data processing.

Even then, decisions are surrounded by the considerable uncertainty of when and how information technology will change, with what consequences for the sort of functions of interest to the end user.

- End user software - there is a bewildering array of software packages available to the end user. The choice of what package, what version, when to acquire and at what cost are all important and difficult questions. However, as we have seen from the earlier points, your options are limited by the other "systems" options and by uncertainty due to change.

These six points serve to indicate that the end user may not be able to avoid many of the traditional "computer center" problems which have challenged data processing professionals. In other words, as indicated above, the power and elegance of new information technology, not only offers the end user the promise of powerful technological support but it also comes "bundled" with many generic DP challenges. These challenges are insidious because the end user is not prepared for them and not forewarned by the vendors and may not place them in the proper perspective because they are not recognized as generic data processing problems.

6. **Making computers personal does not affect the essential complexity of planning**

The last point spoke of the persistent complexity of computer based information systems even though computers are now slickly packaged as consumer items and sold in department stores like toys or pets. There is a corresponding observation that deals with the perception that the new information technology will simplify management or decision processes, or in our case planning processes, by automating some of the steps or procedures. This conclusion seems to arise because of a confusion in the role of information in decision support.

There are many ways to characterize the main elements of the process of developing and implementing a plan at the institutional

level. For our purposes, let's agree that the process is fairly represented by steps such as the following eight:

- Formulation and statement of general goals.
- Formulation and statement of objectives for a period.
- Planning of programs to meet objectives.
- Declaration of programs to be added or deleted.
- Implementation of these decisions.
- Report on activities and outcomes.
- Evaluation of activities and outcomes.
- Initiate review of objectives or programs.

Two additional considerations are "who" is involved in each step and "what" do these people provide to the process at each step? In many cases, "information" is supplied by participants but other inputs include assumptions, reviews, proposals, recommendations, assessments, commitments, judgements, measurements, and decisions. It seems necessary to appeal to the familiar steps of the planning process and the role of information as input to circumscribe the relatively modest impact of information on the intrinsic complexity of planning which is fundamentally structural and not so dependent on inputs.

The above argument does not deny the possibility of significant impacts of new information technology on planning in higher education. Personal computers offer the potential that decision makers will be better informed and equipped to use the information, to communicate and to test their own hypothesis at each stage. However, the framework for this enhanced information is still the planning process, thus the bound is set on the influence of personal computers. None of the essential steps can be removed by the application of information technology even though institutions can greatly improve planning processes and firms can dramatically change their competitive position through the application of information technology in planning processes (McFarlan, 1984). Such valuable results are achieved primarily by improvements in efficiency and effectiveness of processes and inputs not by removing any of the essential steps in planning.

Conclusions

New information technology offers the planner in academic subunits promise of information and decision support that is not ordinarily available from campus data processing services. We have seen that these technologies are powerful and flexible and that, in both practical and theoretical terms, end users can realize systems that meet their needs and their expectations. However, we have also learned that as remarkable as the new technology is, it does not eliminate or remove generic problems in information systems which arise because of the inherent complexity of decision support systems and the nature of planning. It is easy to believe, on the basis of advertising about the increasing power and decreasing cost of these technologies, that more of the problems and challenges of planning and information to support planning have been automated out of the planner's concern. Instead, we found that in becoming end users of the technology, planners have become heir to certain predictable data processing problems. The momentum of information technologies suggests that these problems too will pass with advancing technology. However, when these are recognized as generic and long standing challenges in data processing, it is easier to argue that these problems may be part of the price that planners must pay for the benefits of personal information systems.

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Technical Notes

1. The alternative to transferring the data from the IBM mainframe to the project micro would have been to enter the data manually and create the data base using the "screens" developed by the nonprocedural language. This would be a time consuming activity and because we would be building the same flat files rather than a relational data base, the operator keying the data would have to act on all data cells not just those that were not null. For example, for each student the operator would be presented with a data entry form for each course in the curriculum whether the student had taken the course or not.

2. Though NPL could easily handle this wide record, it was found that the PRO could not and that it was limited to a file of 256 characters wide — at least for transferring files from the host. What this meant was that the wide file on the host had to be divided into a left "half" and a right "half" which could each be transferred separately, and then combined. Though it was comparatively easy to make two halves on the host with SNOBOL, it was not clear how they could be combined side-by-side within NPL. This was solved with a call to the NPL developers who suggested a rather involved but not too complex method of building dummy files with an empty right half and an empty left half and then combining the two through a control break reporting procedure whereby the left and right half of each record were reunited and all accessible in NPL.

3. Because of the print format requirements, the grade field in a course will print as 0.0 if a student has not yet enrolled, is currently enrolled, or received a 0.0 grade point (F) for that course. This simplification of the data makes it necessary for the user to have a sophisticated understanding of the logic of the language so that reports properly account for the different meanings of "0" in the grade field.

4. A master file created by the process of indexing a data file is not comparable with the originating data file. Hence, one has to keep close account of the pairs of master and data files.